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(54) Polling method in a radio data packet communication system.

(57) A central station (101) continuously transmits a slot of predetermined time length which comprises a polling frame P_{xx} and a downward data frame I_{xx}. After receiving the upward data frame D_{xx}, it sequentially and repeatedly carries out an individual polling of upwardly communicating terminal stations (102,103) at a time interval which is more than the predetermined time interval for the polling frame P_{xx}. Unspecified polling is carried out of unspecified terminal stations by a polling frame Po which does not carry out this individual polling. Independently of the polling frame P_{xx}, the downward data frame I_{xx} is repeatedly transmitted to downwardly communicating terminal stations (104,105). The polling frame P_{xx} and the downward data frame I_{xx} which are included within the same slot are transmitted to a terminal station (106) which is in the upward and downward duplex communication mode at a time interval longer than the predetermined time interval. The terminal stations (102-106) transmit a polling request R_{xx} or an upward data frame D_{xx} to the polling frame P_{xx} from the central station (101) at a time interval longer than the predetermined time interval.

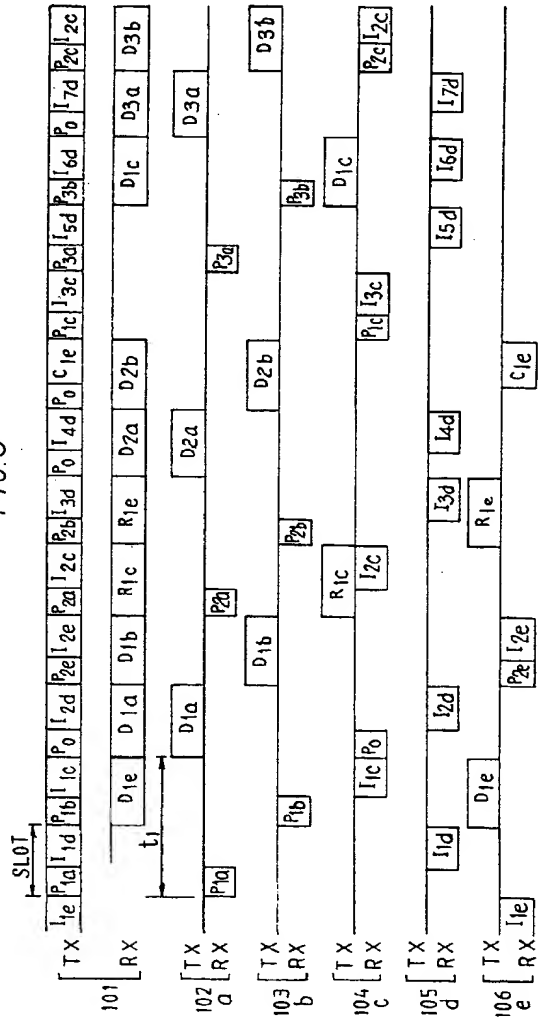

FIG.6

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Background of the Invention

Field of the Invention

The present invention relates to radio data communication and particularly to a radio data packet communication system in a mobile communication system comprising a base station, which is called a central station, and a plurality of mobile stations, which are each a terminal station.

Description of the Related Art

As shown in Fig. 1, in data communication in mobile communication systems, it is necessary that two-way communication be possible, such as transmission from a central station 101 toward terminal stations 102 through 107 (hereinafter referred to as downward communication) and transmission from the terminal stations 102 through 107 toward the central station 101 (hereinafter referred to as upward communication) and that contention between the transmissions by a plurality of stations be prevented. To this end, in conventional systems, the central station 101 sequentially inquires of each of the terminal stations 102 through 107 whether any information is to be sent in accordance with an inquiry sequence, and, if any one of the stations responds to the inquiry, the data transmission is permitted (that is, a polling system). A radio channel 108 is established between the stations which may be alternately used for upward communication or downward communication. In other words, this system enables half-duplex communication by both stations. With this upward or downward communication, a single message may occasionally be transmitted as one unit, but usually, in order to utilize a small number of circuits common to a multiple number of stations, this message is finely divided into packets which are accommodated within a short time interval slot or frame to be multiplexed (time division multiplex system).

However, as shown in Fig. 2, according to a conventional polling system, the order in which the polling of the terminal stations 102 through 106 is carried out is previously fixed, although a downward data frame T_{xx} transmitted to the terminal stations 102 through 106 is accommodated within the same time slot together with a polling frame P_{xx} of the same terminal address. During polling, all of the terminal stations are uniformly polled in a fixed order regardless of whether there is data to be transmitted or not, and as a result, time slots D_{1c}, D_{1d} and D_{2d} or frames I_{1a}, I_{2a}, I_{1b} and I_{2b}, which are allocated to the terminal stations having no upward or downward data, are wasted. Even so, the interval of the time slot allocated to the upwardly or downwardly communicating terminals becomes longer, meaning that the utilization factor of the radio channel is limited to a low value.

Summary of the Invention

Accordingly, an object of the present invention is to provide a polling method in a radio data packet communication system which is analogous to a full duplex communication system and which may effectively process data communication traffic and carry out upward and downward communication concurrently by eliminating the above-described drawbacks.

According to the present invention, the above-described object may be achieved by having the central station which;

(a) sends continuously a series of the time slots of predetermined length, each polling frame of the time slot being either an individual polling frame which polls a specific terminal station or an unspecified polling frame which polls a plurality of unspecified terminal stations, a polling frame and downward data frame both having a respective address,

(b) sends the individual polling frames uniformly and sequentially to one or more terminal stations which are in the upward communication when a longer time elapses than is required for each terminal station to switch from the transmit mode to the receive mode after receipt of the upward data frame,

(c) sends the unspecified polling frames to all terminal stations which are not in the upward communication, these frames being within time slots other than the time slots for the individual polling frames, so as to invite the polling request from those terminal stations,

(d) sends succeeding downward data frames uniformly and sequentially to one or more stations in the downward communication by the address specified in each downward data frame.

The above and other objects, features and advantages of the present invention will become apparent from the following description in conjunction with the accompanying drawings which illustrate a preferred embodiment of the present invention by way of example.

Brief Description of the Drawings

A specific embodiment of the present invention is hereinafter described with reference to the accompanying drawings.

Fig. 1 is a schematic diagram of a radio data packet communication system in a mobile communication system.

Fig. 2 is an example of a timing chart of the prior art.

Figs. 3 and 4 are respectively a block diagram of a central station and terminal stations constituting a system according to a specific embodiment of the present invention.

Fig. 5 illustrates the format of a polling frame, a command frame and upward and downward frames by way of example.

Fig. 6 is an example of a timing chart according to the present invention.

Detailed Description of the Preferred Embodiments

Referring to Fig. 3, a central station 101 is connected to a host computer 301 and comprises a controller 302 for carrying out communication control and protocol conversion, a transmitter 303 for modulating an entered signal to convert it into a radio wave, a receiver 304 for demodulating a received radio wave, an antenna 306, and a duplexer 305, which provides a full duplex mode function for constant transmission of a radio wave from the transmitter 303 to the antenna 306 while sending a radio wave from the antenna 306 to the receiver 304.

Referring to Fig. 4, each of the terminals 102 through 107 has a simplex function and is connected to a data terminal 405 and moreover comprises an antenna 406 similar to that for the central station, a transmitter 402, a receiver 403, a controller 404 and a transmitter/receiver switch 401 which normally lies in the receiving condition, for switching the radio wave from the transmitter 402 to the antenna 406 only when the upward data frame is transmitted according to polling from the central station 101.

Data from the host computer 301 is transmitted as radio waves to the terminal stations 102 through 107 via the transmitter 303, duplexer 305 and antenna 306 by being converted into packets for each address by the controller 302 of the central station 101. This radio wave is sent as the packet data to the control 404 via the antenna 406, transmitting/receiving switch 401 and the receiver 403 of the designated terminal stations 102 through 107 prior to being sent to the data terminal 405 converted to protocol or the like.

Fig. 5 illustrates an example of the format of each frame. A polling frame P_{xx} comprises an address portion for discriminating the terminal station and a control portion for notifying flow control or the like. A command frame C_{xx} and a downward data frame I_{xx} also each comprise an address portion for discriminating the terminal station, a control portion for notifying the classification or termination of the command frame and downward data frame and an information data portion used in operation.

The first suffix (1 - 7) of all frames shows the sequential number of the frame transmitted or received to each terminal station, and the second suffix (a - e) distinguishes each of the terminal stations 102 - 107.

The operation of this embodiment is described with reference to the timing chart of Fig. 6. The polling frame P_{xx} and the downward data frame I_{xx} are alternately transmitted in a continuous manner. A response frame R_{xx} from the terminal stations 102 and 103 in the upward communication mode or the polling frame P_{xx} for inviting the upward data frame D_{xx} are each assigned specific addresses so as to uniformly and sequentially poll each of the terminal stations 102 and 103. In addition, a no-address polling frame Po for inviting the response frame R_{xx} from an unspecified terminal stations not in upward communication is transmitted at appropriate time intervals except when any terminal station is carrying out upward communication. If neither of the terminal stations is in the upward communication mode, all of the polling frames P_{xx} are transmitted as Po.

In addition, the downward data frames I_{xx} are each assigned their own address so that they may be uniformly transmitted to the terminal stations 104 and 105, which are in the downward communication mode. At this time, the transmission cycle for the same terminal station is determined according to the length of time required for the terminal station to be switched between the transmit/receive modes in accordance with the half duplex system. In this embodiment, it is set to a four-slot cycle. In addition, if the same terminal station 106 is simultaneously in the upward and downward communication modes, the polling frame P_{xx} and the downward data frame I_{xx} of the same addresses are continuously transmitted as a single slot.

The timing chart of Fig. 6 illustrates an example in which the terminal stations 102 through 106 are communicating with the central station 101 via the same radio channel.

The terminal stations 102 and 103 are each in the upward communication mode. The terminal station 102 receives and detects the polling frame P_{1a} of the central station 101 and transmits the upward data frame D_{1a} after a certain period of time t1 of about two slots. The central station 101, after transmitting the polling frames P_{1b} and P_{2e} and the unspecified polling frame Po for the other terminal stations 103 and 106, transmits the polling frame P_{2a} for the terminal station 102. The terminal station 102 correspondingly transmits the upward data frame D_{2a}. The operation of the terminal station 103 is also similarly conducted.

The terminal stations 104 and 105 are each in the downward communication mode and, further, the terminal station 104 starts the upward communication mode during the downward communication mode. After receiving the downward data frame I_{1c}, the terminal station 104 detects the unspecified polling Po to transmit a response frame R_{1c} at a predetermined time to request a polling for its own station to the central station 101. The central station 101 which receives this response frame R_{1c} transmits a polling frame P_{1c} addressed to the terminal station 104 immediately before the next downward data frame I_{3c} is sent. Upon receipt of the downward data frame I_{3c}, the terminal station 104 detects the absence of the serial numbers

or the like of the control portion of the downward data frame I_{3c} and transmits an upward data frame D_{1c} which notifies that the downward data frame I_{2c} could not be received. The central station 101 transmits again the downward data frame I_{2c} when it receives this data frame D_{1c}. The terminal station 105 carries out only downward communication. In this case, the other terminal stations 104 and 106 in the downward communication mode are each turned into the upward and downward two-way communication mode from the first or midway, and the downward data frames I_{xc} and I_{xe} from the central station 101 are transmitted in a four or more-slot cycle together with the polling frames P_{xc} and P_{xe}. Therefore, these intermediate empty downward data frames are allowed to be allocated to the terminal station 105 so that the downward data frames I_{1d} through I_{7d} may be transmitted to the terminal station 105 in a short cycle.

The terminal station 106 relates to a case in which it terminates the upward and downward communications midway. In synchronism with receiving the polling frame P_{2e}, the terminal station 106 transmits a response frame R_{1e} to notify termination of the upward communication. The termination of the downward communication from the central station 101 is notified to the terminal station 106 by a command frame C_{1e}.

A response frame R_{xx} and an upward data frame D_{xx} each comprise: a similar address portion; a control portion for classifying the response frame or upward data frame, requesting the polling, and notifying the termination of the frame; and an information portion used in operation.

Although a preferred embodiment of the present invention has been shown and described in detail, it should be understood that various changes and modifications may be made without departing from the scope of the appended claims.

Claims

1. A polling method in a radio data packet communication system comprising a central station which is capable of full duplex mode and a plurality of simplex mode terminal stations which communicate with each other via a time division multiplex system of the same radio channel, said central station sending a series of data in the time slots successively as downward transmission, each of said time slots comprising a polling frame and one of either a downward data frame or a command frame, each of said terminal stations polled by said polling frame transmitting one of either a response frame or an upward data frame, wherein said central station

   (a) sends continuously a series of said time slots of predetermined length, each of said polling frames of said time slots comprising either an individual polling frame which polls a specific terminal station or an unspecified polling frame which polls a plurality of unspecified terminal stations, said polling frame and said downward data frame both having an address respectively,

   (b) sends said individual polling frames uniformly and sequentially to one or more said terminal stations in upward communication when a longer time elapses than is required for each of said terminal stations to switch from the transmit mode to the receive mode after receipt of said upward data frame,

   (c) sends said unspecified polling frames to all terminal stations which are not in upward communication within the time slots other than the time slots for the individual polling frames, so as to invite polling requests from those terminal stations,

   (d) sends succeeding downward data frames uniformly and sequentially to one or more stations in downward communication by the address specified in each downward data frame.

2. A polling method in a radio data packet communication system as claimed in claim 1, wherein said central station sends each downward data frame addressed to terminal stations in upward communication, including in the same time slot of the polling frame addressing the same terminal station.

3. A polling method in a radio data packet communication system as claimed in claim 2, wherein said radio channels between said central station and said terminal stations are established by a single radio channel.

4. A polling method in a radio data packet communication system as claimed in claim 2, wherein said radio channels between said central station and said terminal stations are established by a multichannel access system on a plurality of radio channels.

5. A central station for use in a polling method in accordance with claim 1.

6. A terminal station for use in a polling method in accordance with claim 1.

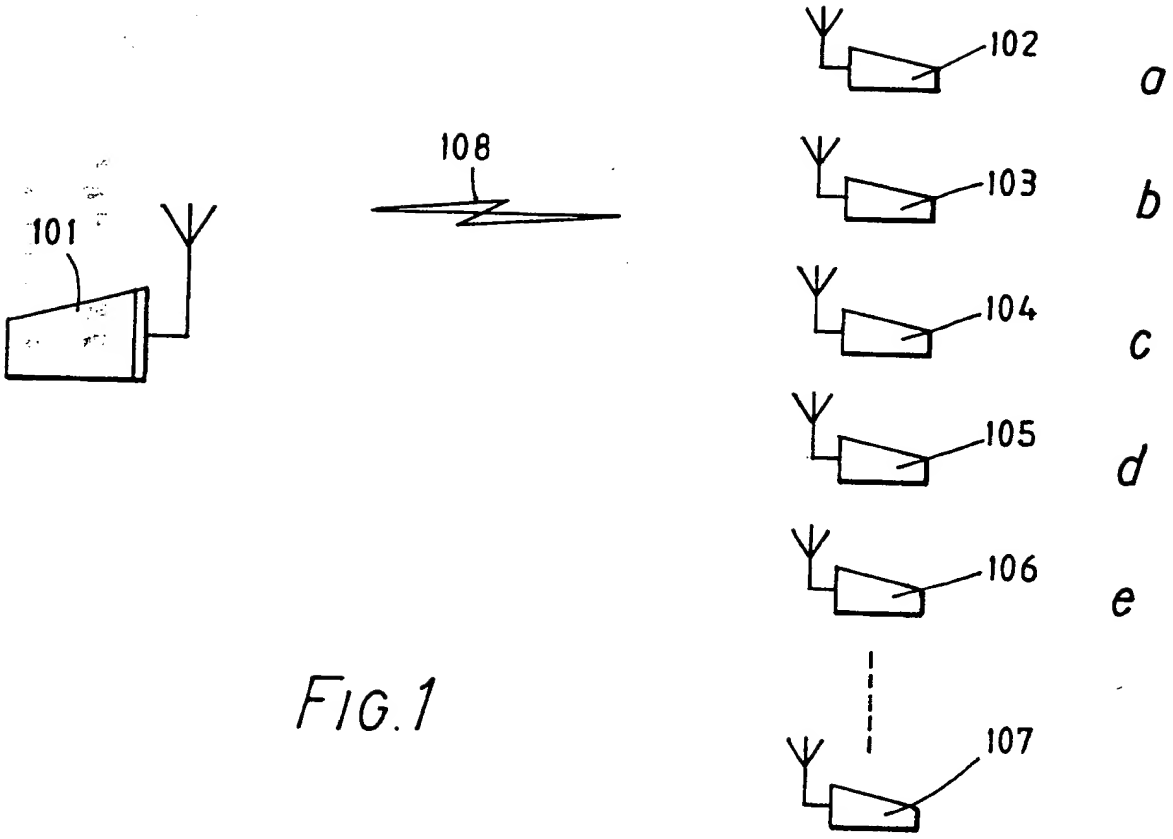


FIG.1

FIG.2

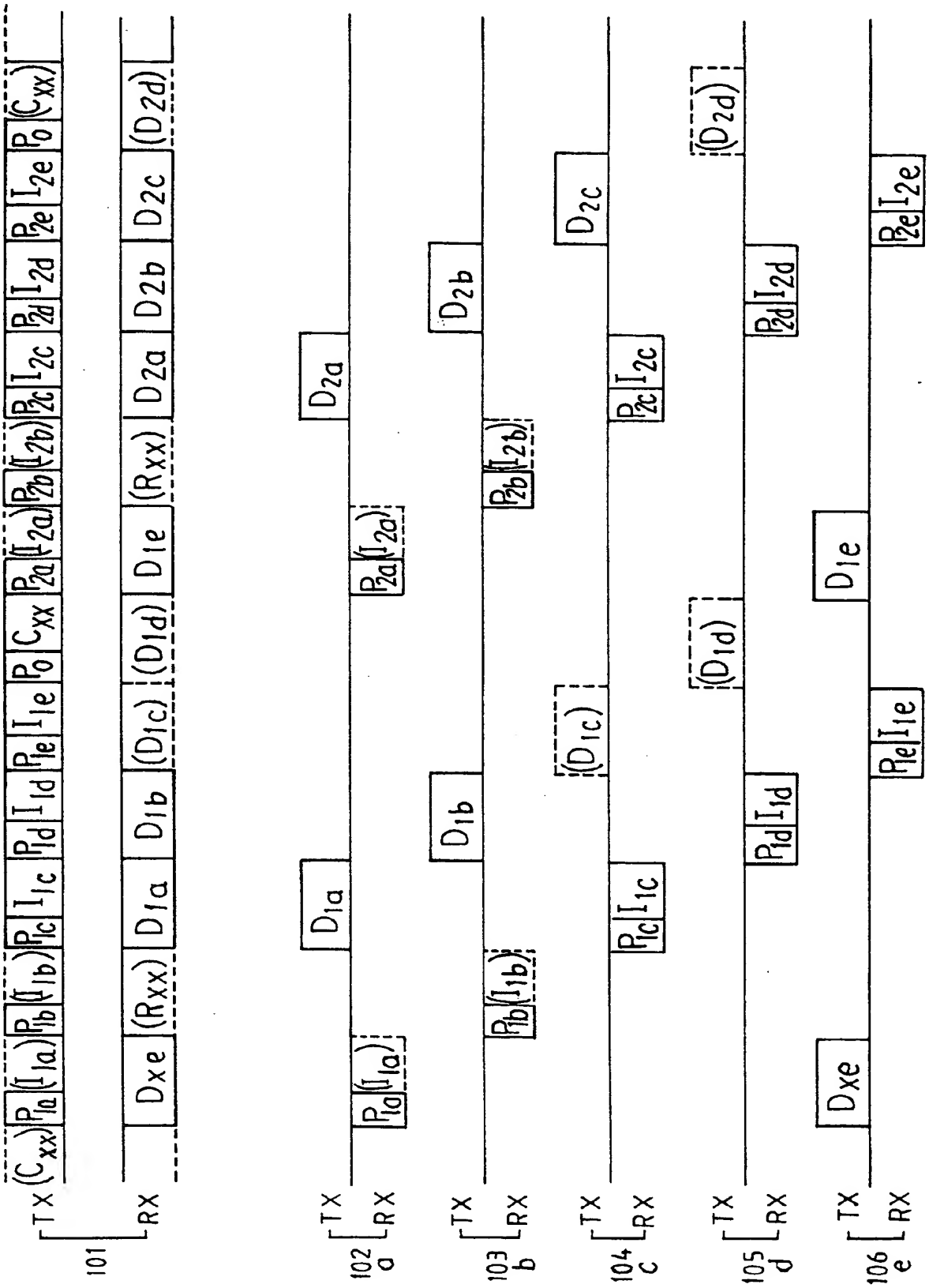

101
TX
RX
(Cxx) P1a (I1a) P1b (I1b) P1c I1c P1d I1d P1e I1e P0 Cxx P2a (I2a) P2b (I2b) P2c I2c P2d I2d P2e I2e P0 (Cxx)
Dxe (Rxx) D1a D1b (D1c) (D1d) D1e (Rxx) D2a D2b D2c (D2d)
102 a
P1a (I1a)
D1a
P2a (I2a)
D2a
103 b
P1b (I1b)
D1b
P2b (I2b)
D2b
104 c
P1c I1c
(D1c)
P2c I2c
D2c
105 d
P1d I1d
(D1d)
P2d I2d
(D2d)
106 e
Dxe
P1e I1e
D1e
P2e I2e

FIG.3

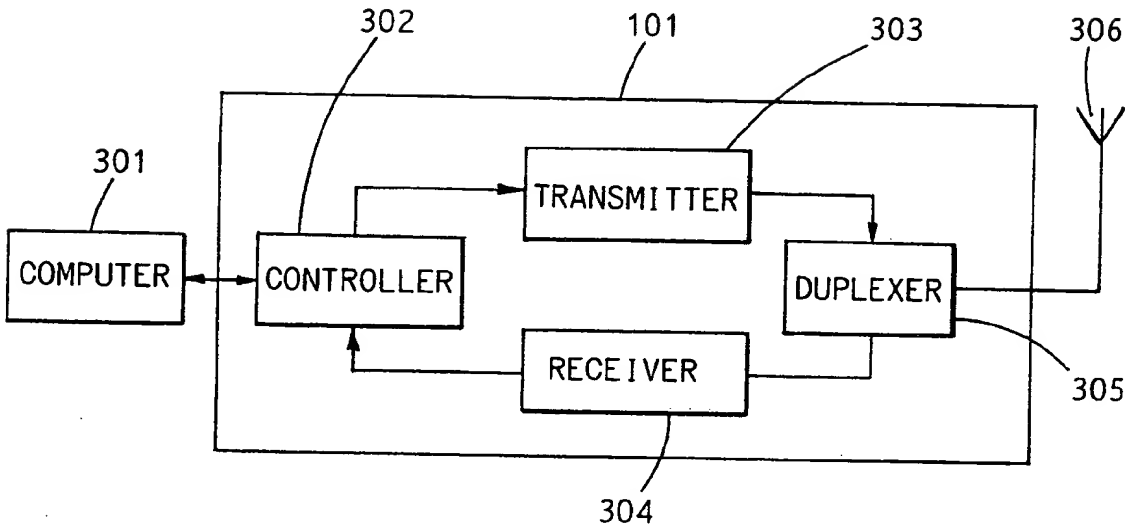


FIG.4

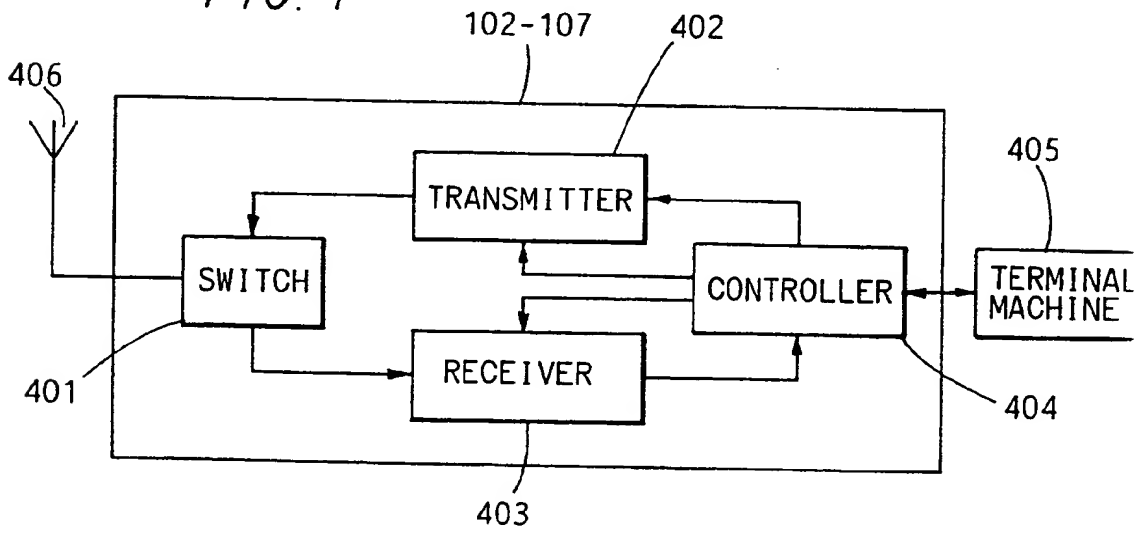


FIG.5

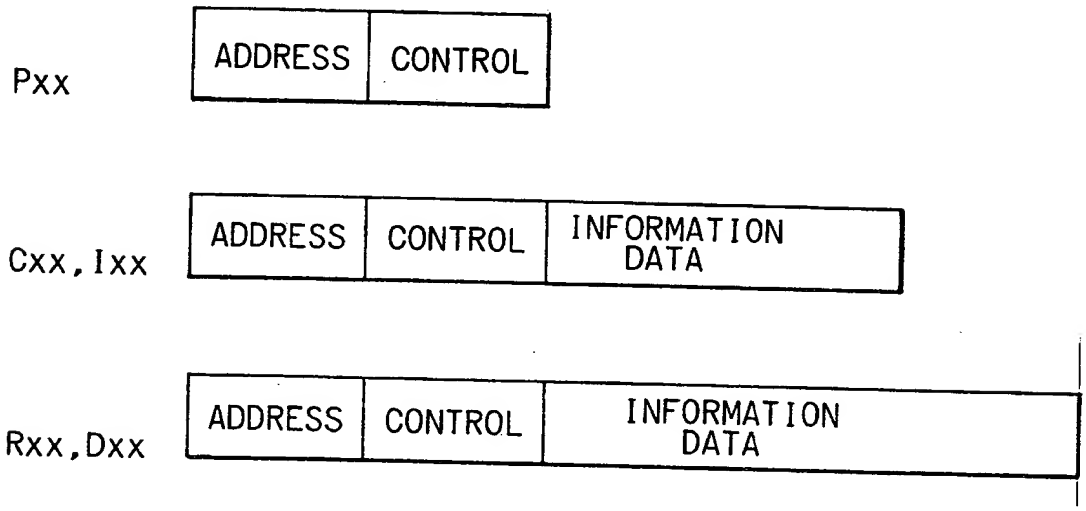
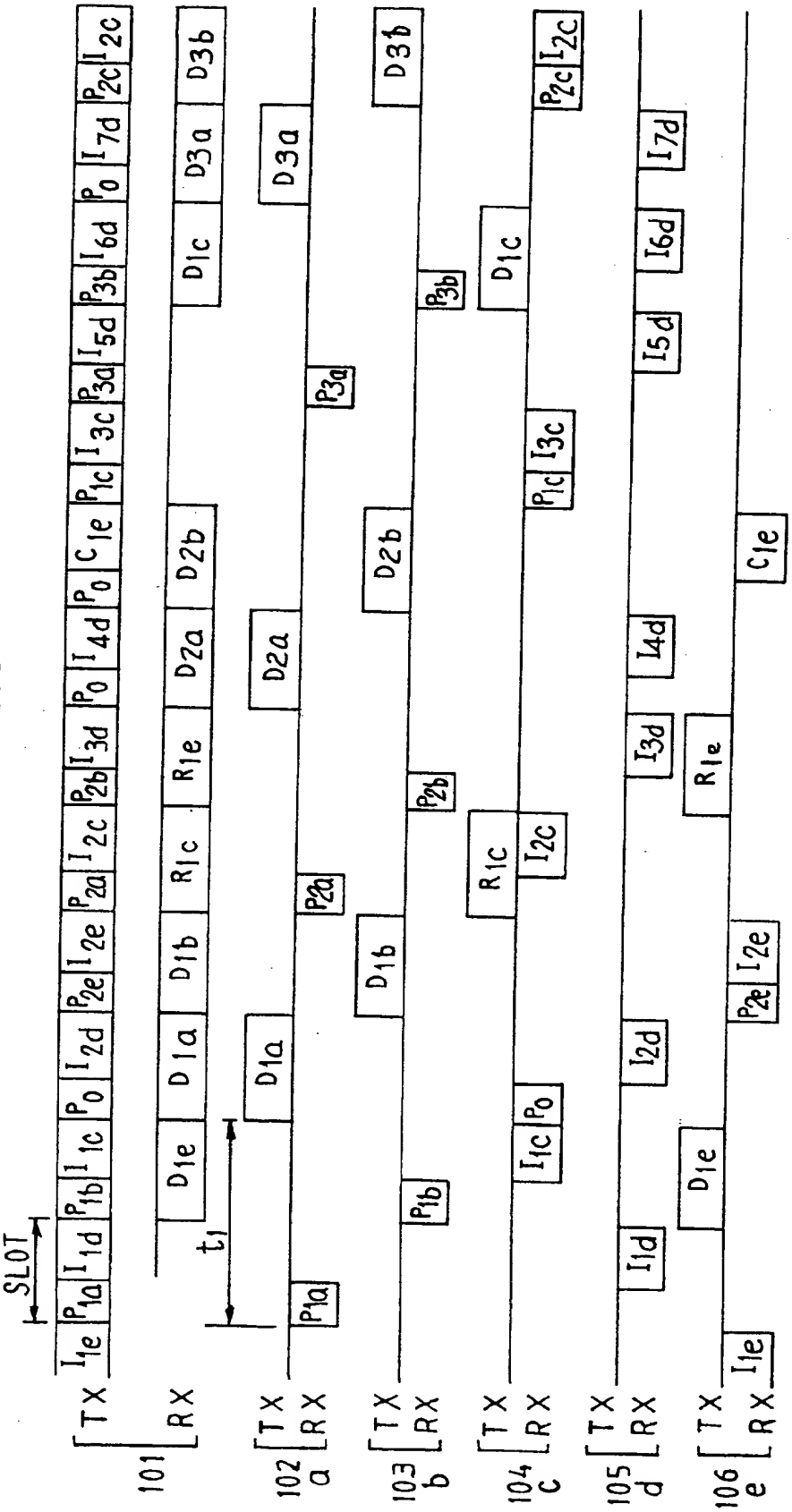


FIG.6



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 30 0254

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-4 466 001 (MOTOROLA)	1	H04L12/40
A	* column 2, line 11 - column 5, line 55 *	2-6	H04L29/06
	---		H04B7/26
A	US-A-4 742 512 (NEC)	1-6	
	* column 5, line 9 - column 7, line 63 *		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H04L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19 MARCH 1992	MESSELKEN M.

CATEGORY OF CITED DOCUMENTS

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